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Abstract

A SYSTEM OF AUTOMATION FOR THE WWR-C-BUCHAREST REACTOR

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The paper describes a system of automation of the principal operational functions of research reactors (in particular the WWR-C Reactor at Bucharest). The chief functions considered are: start-up from zero power; stabilization and operation at a given power level; transition from one power level to another; operation in accordance with a particular power programme; protection of the reactor when a given power level is exceeded.

For start-up, the variation in the signal proportional to the reactor power (8-10 decades) is compressed by means of operational amplifiers whose gain is automatically adjusted (feedback resistors) as a function of the input signal (ionization chamber current). The output voltage of the amplifiers is automatically kept between the limits U_{min}-U_{max} so that there is no need for logarithmic amplifiers over a wide range of power variations.

For start-up and for large power variations the useful control signal (error) is:

$$e_1 = k_1\left(\frac{1}{T} - \frac{1}{T_o}\right)$$

where T is the reactor period.

Since the ratio $\frac{Umax}{Umin} = 5$ is less than one decade, a simple diode function-generator can be used as logarithmic amplifier, the logarithmic function being approximated by three segments.

For stabilization and operation at a given power level $\left[P_o - dP_o < P < P_o + dP_o\right]$ or when the power change is slow, the useful control signal is:

$$e_2 = k_2(P-P_o) + k_3\frac{dP}{dt}$$

The signal required is also chosen automatically as a function of the value of $dP = P-P_o$.

During start-up or during large changes in power level the reactor is protected by the period, and during operation at a given power level protection is achieved by exceeding the level.

Compared with other systems, the one described has the advantage of employing a small number of relatively simple components, thus simplifying checking and maintenance work. The use of operational amplifiers makes it possible to add other computing elements to the system.